## REMARKS

### Objection to Specification

In the previous Amendment filed in this application, the applicant proposed amendments to the specification to overcome an objection to the Abstract for excessive length. Applicant believes that these amendments were properly made, based on applicant's copy of the Specification as filed. However, these amendments were not entered because the Patent Office asserts that the amendments were made to a non-existent section (i.e. page 24 of an alleged 21 page document).

It is believed that the objection is overcome by the present amendment, which amends the Abstract by replacement section, as authorized by 37 C.F.R. § 1.121(b)(2). In view of these amendments, it is submitted that the outstanding objection to the Specification is overcome.

### Amendments to Specification

Table 2 has been amended to include the values of the Fracture Rate X for each of the Examples 1-6 and Comparative Examples 1-6. Table 2 has also been amended to correct errors in the values of the Fractured Micro Hollow Body (wt%) and in the



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values of (D+E)/C. All of these amendments to Table 2 are clearly supported by the application as filed, as described below.

With respect to the filed specification "(E)" was omitted from Table 2 carelessly, therefore "Fractured Micro Hollow Body" has been amended to specify "Fractured Micro Hollow Body (E)" in Table 2.

In support of these amendments, reference is made to page 13, line 33 to page 14, line 18 and examples and comparative examples of the present specification.

The values of X and E ($\gamma X$) can be calculated from the equation (a) with respect to the examples in the present specification as follows:

$$\rho = 100/[\alpha/\rho1 + \beta/\rho2 + \gamma(1 - X)/\rho3 + \gamma X/\rho4] \text{ -- (a)}$$

Equation (a) is solved for X as follows:

$$X=[100/\rho - \alpha/\rho1 - \beta/\rho2 - \gamma/\rho3]\rho3\rho4/[(\rho3 - \rho4)\gamma]$$

The values of parameters in the equation (a) can be calculated from the data shown in the examples and comparative examples as follows.

With respect to $\alpha$ (Percent by weight of wholly aromatic liquid crystal polyester resin): the data of Liquid Crystal Polyester (wt%) in Table 1 of the present specification (page 19).



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With respect to $\beta$ (Percent by weight of inorganic filler having aspect ratio 4 or more): the data of Micro Hollow Sphere C (wt%) in Table 1 of the present specification (page 19).

With respect to $\gamma$ (Percent by weight of inorganic spherical hollow material having aspect ratio 2 or less): the data of Fillers Other Than Micro Hollow Material D (wt%) in Table 1 of the present specification (page 19).

With respect to $\rho$ (Specific gravity of wholly aromatic liquid crystal polyester resin composition): the data of Specific Gravity of Resin Composition in Table 2 of the present specification (page 20).

With respect to $\rho 1$ (Specific gravity of wholly aromatic liquid crystal polyester resin): 1.38 (the value of Specific Gravity of Resin Composition of comparative example 2 in the Table 2 of the specific gravity of the present specification (page 20). In comparative example 2, the resin does not contain any filler.)

With respect to $\rho 2$ (Specific gravity of inorganic filler having aspect ratio 4 or more): 2.54 for glass fiber and 2.77 for Talc (lines 5-9 of page 16 of the present specification).

With respect to $\rho 3$ (True specific gravity of inorganic spherical hollow material having aspect ratio 2 or less): 0.60 for



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S-60 and 0.75 for PZ-6000 (page 15, line32, to page 16, line 4 of the present specification).

With respect to $\rho 4$ (Material specific gravity of inorganic spherical hollow material): 2.50 for S-60 and PZ-6000 (page 15, line32 to page 16, line 4 of the present specification).

Thus calculated values of X are as follows.

X=0.048 (example 1)

X=0.045 (example 2)

X=0.085 (example 3)

X=0.094 (example 4)

X=0.088 (example 5)

X=0.090 (example 6)

X=0.456 (comparative example 1)

X=0.360 (comparative example 3)

X=0.071(comparative example 4)

This data has been added to Table 2 in a new column entitled "Fracture Rate X."

The corrected values of "Fractured Micro Hollow Body E (wt%)" are calculated as $\gamma X$ and corrected "(D+E)/C" are calculated from said corrected E and original D and C shown in Table 1. These corrected values replace the original values in Table 2.



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Therefore, the amendments and corrections to Table 2 are supported by the specification as filed. No new matter has been added.

Amendment to Claim 1

Independent claim 1 has been amended to recite that "the fracture rate X of the inorganic spherical hollow material is 0.045 to 0.094 using the following equation: $\rho = 100/[\alpha/\rho 1 + \beta/\rho 2 + \gamma(1 - X)/\rho 3 + \gamma X/\rho 4]$, where in the equation: $\alpha$ = the percent by weight of the wholly aromatic liquid crystal polyester resin; $\beta$ = the percent by weight of the inorganic filler having an aspect ratio of 4 or more; $\gamma$ = the percent by weight of the inorganic spherical hollow material having an aspect ratio of 2 or less; $\rho$ = the specific gravity of the wholly aromatic liquid crystal polyester resin composition; $\rho 1$ = the specific gravity of the wholly aromatic liquid crystal polyester resin; $\rho 2$ = the specific gravity of the inorganic filler having an aspect ratio of 4 or more; $\rho 3$ = the true specific gravity of the inorganic spherical hollow material having an aspect ratio of 2 or less; $\rho 4$ = the material specific gravity of the inorganic spherical hollow material; X = the fracture rate of the inorganic spherical hollow material; $\gamma(1 - X)$ = the percent by weight of non-fractured inorganic spherical hollow material; $\gamma X$ = the percent by weight of



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fractured inorganic spherical hollow material." Support for these limitations is described above in connection with the amendments to Table 2. In particular, the limitation that the fracture rate X of the inorganic spherical hollow material is 0.045 to 0.094 is supported by examples. In the examples of the present invention, 0.045 is lowest value and 0.094 is highest value.

Claim Rejections

Turning now to the claim rejections, claims 1, 2 and 4-9 were finally rejected under 35 U.S.C. § 103(a) as being unpatentable over 2001/0012862 to Maeda ("Maeda") in view of 5,837,366 to Tanaka ("Tanaka").

Applicant maintains that the present claims are patentable over the cited Maeda and Tanaka references for the reasons set forth in the Amendment filed on June 26, 2008. Furthermore, independent claim 1 has now been amended to specify, *inter alia*, that "the fracture rate X of the inorganic spherical hollow material is 0.045 to 0.094." As discussed below, this limitation regarding the range of fracture rate (X) is an important limitation that further distinguishes the present claims from the cited Maeda and Tanaka references.

To more clearly illustrate the distinctions between the present invention and the cited art, a number of significant



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limitations of independent claim 1 will now be summarized.

According to amended independent claim 1, the following features 1) to 4) are recited for a molded product of a wholly aromatic liquid crystal polyester resin composition.

1) the wholly aromatic liquid crystal polymer includes the following thermal properties:

- a melting point of 320°C or more; and
- an apparent viscosity at a temperature of 20°C above the melting point of the liquid crystal polyester is 5,000 poise or less

2) the wholly aromatic liquid crystal polymer resin composition includes the following composition and ratio (100 percent by weight as a total):

- 45 to 90 percent of a wholly aromatic liquid crystal polyester resin;
- 10 to 40 percent by weight of an inorganic spherical hollow material having an aspect ratio of 2 or less; and
- 0 to 15 percent by weight of an inorganic filler having an aspect ratio of 4 or more.

3) the fracture rate X of the inorganic spherical hollow material calculated using the equation (a) is between 0.045 and 0.094.



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4) the molded product includes the following dielectric properties:

- a dielectric constant of 3.0 or less; and
- a dielectric dissipation factor of 0.04 or less.

As discussed in the present specification, an object of the invention is to provide a molded product that has the dielectric property that the conventional liquid crystal polyester-based material, such as described in Maeda, has not realized. The present invention is able to achieve the desirable dielectric properties of feature 4) as a result of the unique combination of characteristics of features 1), 2) and 3).

In the present invention, the fracture rate X of the inorganic spherical hollow material is calculated using the equation (a) and data of examples and comparative examples.

The X value defined by Maeda has the same meaning defined in the present invention, however, in the present invention X is defined by ratio and in Maeda X is defined by percent.

Maeda limits X to the range of 10% to 50%, which corresponds to the range of 0.1 to 0.5 according to the definition of X in the present invention.

Significantly, with respect to the range of X value, Maeda limits the range to 0.1 to 0.5 and the present invention limits



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<u>the range to 0.045 to 0.094</u>. Therefore, the present invention is clearly distinguishable from the cited Maeda reference.

In the present invention, the dielectric constant of 3.0 or less is achieved by providing a composition having a fracture rate X in the range of 0.045 to 0.094. By contrast, the range of 0.1 to 0.5 in Maeda cannot achieve the presently-claimed dielectric constant of 3.0 or less.

The values of fracture rate X and dielectric constants obtained from the examples 1-6 (E1-E6) and comparative examples 1, 3 and 4 (C1, C3 and C4) in the present application, which are compounded with hollow material, are plotted on the previously submitted Graph 1. Even if this Graph 1 is made from examples and comparative examples of various parameters, it is possible to grasp the relation between X and dielectric constant.

In Graph 1, there is a remarkable difference between the first area in which X is less than 0.1 and the second area of comparative examples 1 and 3. In the first area, even the variation of the fracture rate of hollow material (X) is slight, the dielectric constant changes remarkably. On the contrary, in the second area in which X is more than 0.1, even as X changes, the dielectric constant changes very little, and the value of dielectric constant is always more than 3.0.



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In Maeda, the fracture rate X is from lowest 0.121 (=12.1% Example 3) to highest 0.326 (=32.6% Example 2).

If one plots the fracture rate X of Maeda on Graph 1, since all of X are over 0.1 in Maeda, all of estimated dielectric constant of the examples of Maeda should be over 3.

Furthermore, the Maeda reference does not teach or suggest this significant relationship between very low X values (i.e., $0.045 < X < 0.094$) and a desirable, heretofore unachievable, dielectric constant of less than 3.0 in liquid crystal polyester-based molded products, and one skilled in the art would have no suggestion or motivation from Maeda to provide a liquid crystal polyester composition meeting all the limitations of claim 1.

Furthermore, the limitation of "apparent viscosity at a temperature of 20°C above the melting point of the liquid crystal polyester is 5,000 poise or less" is a significant feature to achieve the presently-recited limitation of a fracture rate X between 0.045 and 0.094.

Please refer to the following description on page 8, lines 1 to 14, of the present specification:

> The liquid crystal polyester which is preferable from the stand point of balance between heat resistance, mechanical property and processability is the resin which contains the above mentioned structural unit



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> represented by ($A_1$) in an amount of at least 30 percent by mol, and more preferably by a total of ($A_1$) and ($B_1$) in an amount of at least 60 percent by mol. By fulfilling the above conditions an inflexibility of the molecular structure is acquired and an excess stress which is provided while melt mixing by a twin-screw extruder and the like and while molding by an injection machine is eliminated so that fractures of hollow materials can be reduced. Also, by decreasing a latent heat of fusion of crystalline part, since a quantity of heat required to melt reduces and the resin easily changes to molten state, not many inorganic spherical hollow materials are fractured in the melt extrusion process under heating. Moreover, by applying the polyester having an apparent viscosity of 5,000 poise or less at the melting point +20 °C of the liquid crystal polyester, the effect can be ensured more.

Maeda does not refer to apparent viscosity and Maeda does not recognize such a relationship between apparent viscosity and the fracture rate of hollow materials. Again, one skilled in the art reading Maeda would have no suggestion or motivation to provide a liquid crystal polymer composition as defined by the present claims.

With respect to the relationship between the content of hollow material and dielectric constant, reference is made to the following description on page 2, lines 23 to 29, of the present specification:



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> In order to decrease the relative dielectric constant of the molded product, a method is considered to compound spherical hollow material fillers containing air which has the reduced dielectric constant. However, if the product for electronic part having a portion of thickness less than 0.5 mm is produced by injection molding method, compounded hollow filler may be destroyed so that the compounded effect is deprived and the improvement effect of the relative dielectric constant is reduced.

In examples 1 and 2 and in comparative example 1 of the present specification, the same liquid crystal polymer material (Liquid Crystal Polyester A) and inorganic spherical hollow material (S-60, manufactured by Sumitomo 3M Limited) are used, though the contents of the spherical hollow material differ in the examples.

For example, comparative example 1 contains more hollow material than either examples 1 and 2. However, the value of dielectric constant of comparative example 1 is greater than 3.0, while the value of the dielectric constant for examples 1 and 2 is less than 3.0, even though comparative example 1 contains more hollow material. These results are contrary to expectations.

Furthermore, comparative example 1, which contains increased content of hollow material, shows troubles of flowability and



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surface property (please refer to Table 1). Therefore, this composition can not be used for commercial products.

As discussed in the previous Amendment of June 26, 2008, (see page 13, line 1 to page 14, line 11), if the hollow material is fractured during a process for producing a compound or a process for molding a product, the density of the product increases and the dielectric constant of the product increases, therefore performance of the product is reduced. Thus, merely increasing the content of the hollow material will not guarantee a desirable dielectric property. This is not recognized or apparent from the teachings of the cited references.

Therefore, according to the present invention, a molded product having a dielectric constant of 3.0 or less and a dielectric dissipation factor of 0.04 or less provides suitable dielectric properties for information transmission equipment and excellent heat resistance, as well as excellent flowability suitable for molding a product having a thin part having a thickness of 0.5 mm or less, for example.

These unexpected results are obtained by using a liquid crystal polymer having a excellent flowability and by limiting a fracture rate (X) of the hollow filler material. The flowability feature minimizes the fracturing of hollow filler material during



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a molding process. This flowability feature is recited in the present claims as an apparent viscosity of 5,000 poise or less, as measured at a temperature of 20 deg. C above the melting point of the wholly aromatic liquid crystal polyester. However, the limitation of range of 0.045 to 0.094 for fracture rate (X) of the hollow filler material is significant to achieving a dielectric constant of 3.0 or less.

Furthermore, Maeda does not teach any liquid polyesters compound having a dielectric constant of 3.0 or less, nor does Maeda disclose or suggest the flowability of a liquid polyester material as presently recited, and significantly, Maeda does not teach or suggest the specific range of fracture rate of hollow filler material of 0.045 to 0.094 for achieving such a low dielectric constant.

As discussed in the Amendment of June 26, 2008, the secondary reference to Tanaka discusses a polyphenylene sulfide resin composition comprising 40-70 wt % of a polyphenylene sulfide resin composition, 18-30 wt % of a polytetrafluoroethylene powder having an average particle diameter of 1-5 micro meter, 2-7 wt % of a polyolefin resin, and 10-40 wt % of a fibrous reinforcing material. The polymers described in Tanaka (polyphenylene sulfide, polytetrafluoroethylene and polyolefin) are clearly



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different from the liquid crystal polyester of the present invention. Also, Tanaka does not teach or suggest a hollow spherical material. Therefore, since Maeda and Tanaka describe such different materials, there is no suggestion or motivation to combine these references, and the deficiencies with respect to Maeda cannot be overcome by reference to Tanaka. Furthermore, Tanaka does not teach the presently-recited dielectric constant and dielectric dissipation factor. These are claimed features of the present invention and are achieved by the composition comprising a wholly aromatic liquid crystal polyester having a melting point of 320 deg. C or more and an apparent viscosity at a temperature of 20 deg. C above the melting point of the polyester of 5,000 poise or less, and an inorganic spherical hollow material having an aspect ratio of 2 or less with a fracture rate between 0.045 and 0.094.

Accordingly, it is believed that the rejection of independent claim 1 is overcome, and that all claims are allowable.

Double Patenting

The provisional rejection of claims 1-9 for double patenting over the claims of co-pending application no. 11/578,980 is acknowledged. Applicants will address any outstanding double



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patenting issues once allowable claims are found in this application or in the 11/578,980 application.

The Examiner is encouraged to telephone the undersigned attorney to discuss any matter which would expedite allowance of the present application.

Respectfully submitted,

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